Maryland State STEM Standards of Practice Instructional Guide Grades 3-5

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Table of Contents

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Introduction

STEM Education

STEM education is an approach to teaching and learning that integrates the content and skills of science, technology, engineering, and mathematics. STEM Standards of Practice guide STEM instruction by defining the combination of behaviors, integrated with STEM content, which are expected of a proficient STEM student. These behaviors include engagement in inquiry, logical reasoning, collaboration, and investigation. The goal of STEM education is to prepare students for post-secondary study and the 21st century workforce.

STEM education removes the artificial barriers that isolate content and allows for an integrated instructional approach. The curriculum should allow students to develop life skills and apply content knowledge within a real world context. STEM education is active and focuses on a student-centered learning environment. Students engage in questioning, problem solving, collaboration, and hands-on activities while they address real life issues. In STEM education, teachers function as classroom facilitators. They guide students through the problem-solving process and plan projects that lead to mastery of content and STEM proficiency. STEM proficient students are able to answer complex questions, investigate global issues, and develop solutions for challenges and real world problems while applying the rigor of science, technology, engineering, and mathematics content in a seamless fashion. STEM proficient students are logical thinkers, effective communicators and are technologically, scientifically, and mathematically literate.

STEM Education Pipeline

Elementary School

The development of STEM proficient students begins in elementary schools. In the elementary grades, students apply the rigor of science, technology, engineering, and mathematics content and the STEM Standards of Practice while engaged in learning activities that investigate the natural world. Students explore technology and engineering solutions and appropriately apply the concepts of mathematics in order to understand and address real life issues and solve problems or challenges. As students progress through elementary school they will begin to independently integrate the STEM Standards of Practice. They will understand how to apply the roles and views of STEM career professionals and analyze real world STEM issues, problems, or challenges as they incorporate STEM content, skills, and practices and other disciplines such as social studies, performing arts, health, and creative movement.

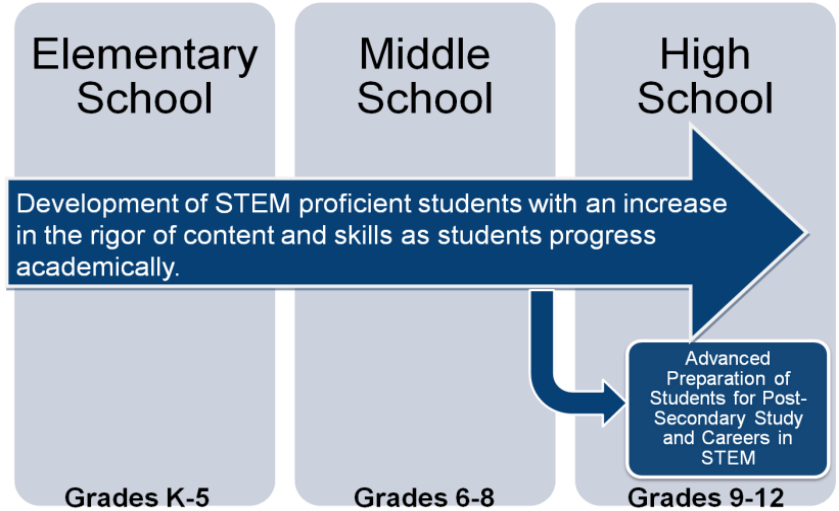
Middle School

STEM education in middle school builds upon the foundational skills developed by students throughout elementary school. STEM essential skills and knowledge are further developed through guided instruction by the middle school teacher. Teachers facilitate learning activities that intentionally allow for middle school students to analyze and integrate content from science, technology, engineering, and mathematics to investigate global issues, answer complex questions, and develop solutions for challenges and real world problems. Middle school students will ask relevant questions, conduct research, refine questions based on research, and develop new questions that are relevant to understanding problems, global issues, or challenges. Teachers will also facilitate learning activities that allow middle school students to refine critical thinking skills by applying scientific investigation and the engineering design process. By the end of eighth grade, students will be able to independently synthesize multi-disciplinary content to answer complex questions, investigate global issues, and develop solutions for challenges and real world problems.

High School

There are two goals for STEM education in high school. The first goal is on the development of STEM proficient students. All students will continue to grow in their STEM proficiency as they progress from grades 9-12. Students demonstrate independence and become more focused and sophisticated in their approach to answering complex questions, investigating global issues, and developing solutions for challenges and real world problems. STEM proficient students graduate with the basic skills and knowledge required to pursue post-secondary study or work in any field.

The second goal for STEM education in high school is on the advanced preparation of students for post-secondary study and careers in science, technology, engineering, or mathematics. High school provides a unique opportunity for students to explore different career paths and college majors through advanced coursework, career academies, magnet programs, STEM academies, specialized STEM programs, internships, and dual enrollment opportunities. Specific programs to address the needs for advanced preparation of students shall be determine by individual schools systems.



Overview:

In September 2008, Governor Martin O'Malley convened a P-20 STEM Task Force to discuss the state of STEM education in Maryland. As a result of the task force work, specific recommendations were made aimed at establishing Maryland as a global leader in the development of its workforce of the future, STEM-based research, and economic development infrastructure. The task force's recommendations were included in Maryland's application for a Race to the Top Grant. The grant describes twelve STEM-related projects, including developing STEM-based curriculum. The curriculum development process began in 2011 when Maryland State Department of Education staff specialists joined with stakeholders from across the state to define STEM education and develop STEM Standards of Practice. A total of 961 stakeholders reviewed and provided input on the STEM Standards of Practice via an on-line survey and face-to-face meetings. Stakeholders included representatives from all 24 Maryland local school systems, businesses and governmental agencies, colleges and universities, and other members of the community. In April 2012, the Maryland State Board of Education accepted the Maryland State STEM education definition and STEM Standards of Practice.

The development of the Maryland State STEM Standards of Practice Frameworks began in 2012 when the Office of STEM Initiatives convened multidisciplinary design teams. Design teams consisted of Maryland educators representing grades K-12 and higher education. The design teams identified what students should know and do to demonstrate proficiency with each STEM Standard of Practice by the end of grades K, 2, 5, 8, and 12. The Maryland State Department of Education staff and other stakeholders reviewed and refined the work of the design team. This document represents the culminating work of the design team and other stakeholders in identifying the essential skills and knowledge of STEM proficient students.

The purpose for the Maryland State STEM Standards of Practice Frameworks is to lay a foundation of STEM Education for all students. The Frameworks provide teachers and students a consistent approach to implementing STEM education and will provide guidance for teachers as they develop STEM centric units or lessons that focus on answering complex questions, investigating global issues, and developing solutions for challenges and real world problems.

Implementation of the Maryland State STEM Standards of Practice Frameworks

The Maryland State STEM Standards of Practice cross all grade levels and disciplines. Instruction in STEM education is a shared responsibility within a school. Therefore, all classroom teachers, supporting teaching staff, and special area teachers (e.g.: special education, gifted and talented, enrichment programs, afterschool programs, summer programs) can use the Maryland State STEM Standards of Practice Frameworks to engage students in STEM activities and tasks that develop STEM proficiency. Students should be given the opportunity to practice the essential skills and knowledge described while learning content. Implementation could occur through projects/themes that span multiple disciplines or through appropriate content-based infusion.

Limitations of the Frameworks

1. The Maryland State STEM Standards of Practice Framework sets the foundation for curriculum development by identifying process standards that are designed to be used with content standards.
2. The Maryland State STEM Standards of Practice are holistic in nature and have equal importance towards the development of STEM proficient students. The Framework is not intended to convey a hierarchical or sequential order for essential skills and knowledge, proficiencies, or standards.
3. The Maryland State STEM Standards of Practice Framework are written in grade bands to give school systems flexibility in the incorporation of STEM Standards of Practice in various content areas. Teachers should promote the development of the essential skills and knowledge over the course of grades K-5, 6-8, and 9-12.
4. The Maryland State STEM Standards of Practice Framework is a curriculum guide for educators. Teachers will need to plan accommodations, interventions, or enrichments required for special need students, English language learners, or gifted and talented students. Individual school systems can determine the appropriate modifications to meet the needs of their diverse populations.

STEM Education in Elementary Schools

In elementary STEM classrooms, students are actively engaged in questioning and hands-on activities while they investigate global issues, and solve real world problems, and/or challenges. Teachers facilitate student engagement, arouse student's questioning, guide students through the problem-solving process, and plan student projects that center on student's interest. As early as kindergarten, their learn to: ask and answer questions about real-life topics that affect their lives and the lives of others around them, solve problems, and explore STEM-related careers by learning and role-playing what scientists, technologists, technicians, engineers and mathematicians do in their career field. Grade: Kindergarten, students should have been introduced to STEM Standards of Practice that will engage them in scientific process, Maryland Technology Literacy Standards for Students, engineering design processes, and mathematics content and practices.

As students mature in age, first and second grade students begin to apply, with some assistance from the teacher, science, technology, engineering, and mathematics content while engaging in activities that focus on real-world questions, issues, problems or challenges. Students begin to independently explore real-world problems, apply the process of problem solving, scientific process, engineering design process, and Standards for mathematical Practices, integrate STEM Standards of Practice, form STEM teams, and work cooperatively and collaboratively in groups.

Grades: First through Second, students will have a clear understanding of STEM content, skills, and practices, and they would have been exposed to inquiry-based, problem-based, and project-:based learning. Beginning in the third grade, students focus on demonstrating an understanding of how to connect science, technology, engineering and mathematics content, practices or processes while engaging in inquiry-based, problem-based, and project-based learning activities. By the end of third grade, students will be able to integrate STEM content, practices and processes to other disciplines when asking questions, solving problems, or meeting challenges. Students should also begin to apply the STEM Standards of Practice that will engage them in scientific process, Maryland Technology Literacy Standards for Students, engineering design processes, and mathematics content and practices.

By the end of fourth grade, students will be able to: design projects that are innovative and creative, analyze complex issues, solve complex problems and/or challenges, and independently apply STEM Standards of Practice into STEM activities. Students role play STEM professionals while engaged in STEM teams, incorporate engineering design process, science practices and Standards for Mathematical Practices into STEM activities, and logical reasoning when addressing or solving STEM related issues, problems, and/or challenges.

Grades: Third through Third through Fifth, students will be able to independently demonstrate grade appropriate proficiency in all four STEM content areas, research various types of STEM subject matter experts in STEM fields, perform a STEM subject matter expert role when engaged in STEM teams, integrate other disciplines when engaging in a STEM lesson and/or project, and evaluate whether they have appropriately applied the STEM Standards of Practice while engaged in STEM activities. Student should also be able to independently demonstrate the science practices and Standards for Mathematical Practices, all K - 5 Maryland Technology Literacy Standards for Students, engineering design process, and inquiry-base, problem-base and project-base learning processes.

K

1 - 2

3 - 5

By the end of Third through Fifth grade, students will master grade level science, technology, engineering, and mathematics (STEM) content, practices, and processes, integrate STEM contents with other disciplines, answer complex questions, investigate global issues, solve real world problems, and meet real world challenges while engaging in meaningful, purposeful, and relevant hands-on inquiry-based, problem-based and/or project-based learning experiences.

Elementary STEM Standards of Practice and Framework

The purpose for having Elementary STEM Standards of Practice and Framework is to lay a foundation of STEM Education for all students. STEM education is embedded in all content areas, specifically science, technology, engineering and mathematics. This document was designed by teachers and STEM coordinators from various grade levels, special education, English language learner, and English for speakers of other languages, and gifted and talented programs.

How to Read this Document

The curriculum writers approached the STEM Standards of Practice holistically: meaning, equal emphasis is given to each STEM Standards of Practice making each STEM Standards of Practice very important. The writers also applied a Transdisciplinary approach to STEM education where students answer complex questions, investigate global issues, and develop solutions to real world problems or challenges.

Overall Document Organization

The STEM Standards of Practice and Framework are comprised of seven practices. Each practice title is listed with a STEM proficient student statement explaining what a STEM proficient student will demonstrate. Each STEM Standard of Practice may list two or more student proficiencies, which are uppercase, letter A, B… A STEM proficiency statement is the behavior students are to demonstrate while engaged in STEM task over a course or year. The section identifying K, 2 and 5 represents Grade: Kindergarten, Grades: First through Second, and Grades: Third through Third through Fifth. The essential skills and knowledge section includes a precursor statement explaining the expectation and support students will need to become a STEM proficient student. This section also contains skills and knowledge students will learn. Note: These bullets are not inclusive of all skills and knowledge students may demonstrate while engaging in STEM activities or tasks. Appendix A includes glossary words, and Appendix B is a list of references and online recourses.

Who is responsible for STEM Standards of Practice and Framework?

STEM is for all students. Therefore, all elementary classroom teachers, support teaching staff, special area teachers: art, music, library, physical education, inclusive or special education, gifted and talented, English language learners, and English for speakers of other languages, enrichment programs, afterschool programs and summer programs can use these STEM Standards of Practice and Framework to engage student in STEM activities and tasks. School administrators can also apply STEM Standards of Practice and Framework into the daily instruction in ELA, mathematics, social studies, science, and other discipline academic time blocks.

Formatting Notes: Black Print – Essential skills and knowledge identified by Maryland educators. These statements are intended to help teachers develop common understanding and valuable insights into what a student must know and be able to do to demonstrate proficiency with each STEM Standard of Practice; **Blue Print** : Glossary terms**;** and ***Purple Print*** – Essential skills and knowledge from other Maryland State Curriculum Standards.

Maryland State STEM Standards of Practice

1. Learn and Apply Rigorous Science, Technology, Engineering, and Mathematics Content

STEM proficient students will learn and apply rigorous content within science, technology, engineering, and mathematics disciplines to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

A. Demonstrate an understanding of science, technology, engineering, and mathematics content.
B. Apply science, technology, engineering, or mathematics content to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

2. Integrate Science, Technology, Engineering and Mathematics Content

STEM proficient students will integrate content from science, technology, engineering, and mathematics disciplines as appropriate to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

A. Analyze interdisciplinary connections that exist within science, technology, engineering, and mathematics disciplines and other disciplines.
B. Apply integrated science, technology, engineering, mathematics content, and other content as appropriate to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

3. Interpret and Communicate Information from Science, Technology, Engineering, and Mathematics

STEM proficient students will interpret and communicate information from science, technology, engineering, and mathematics to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

A. Identify, analyze, and synthesize appropriate science, technology, engineering, and mathematics information (text, visual, audio, etc.).
B. Apply appropriate domain-specific vocabulary when communicating science, technology, engineering, and mathematics content.
C. Engage in critical reading and writing of technical information.
D. Evaluate and integrate multiple sources of information (e.g.: quantitative data, video and multimedia) presented in diverse formats.
E. Develop an evidence-based opinion or argument.
F. Communicate effectively and precisely with others.

4. Engage in Inquiry

STEM proficient students will engage in inquiry to investigate global issues, challenges, and real world problems.

A. Ask questions to identify and define global issues, challenges, and real world problems.
B. Conduct research to refine questions and develop new questions.

5. Engage in Logical Reasoning

STEM proficient students will engage in logical reasoning to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

A. Engage in critical thinking.
B. Evaluate, select, and apply appropriate systematic approaches (scientific and engineering practices, engineering design process, and/or Standards for mathematical Practices).
C. Apply science, technology, engineering, and mathematics content to construct creative and innovative ideas.
D. Analyze the impact of global issues and real world problems at the local, state, national, and international levels.

6. Collaborate as a STEM team

STEM proficient students will collaborate as a STEM team to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

A. Identify, analyze, and perform a STEM specific subject matter expert role.
B. Share ideas and work effectively with a STEM focused multidisciplinary team to achieve a common goal.
C. Listen and be receptive to ideas of others.
D. Analyze career opportunities that exist in a variety of STEM fields relevant to the STEM focused multidisciplinary team's goal.

7. Apply Technology Strategically

STEM proficient students will apply technology appropriately to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

A. Identify and understand technologies needed to develop solutions to problems or construct answers to complex questions.
B. Analyze the limits, risks, and impacts of technology.
C. Engage in responsible/ethical use of technology.
D. Improve or create new technologies that extend human capability

STEM Standard of Practice 1: **Learn and Apply Rigorous Science, Technology, Engineering, and Mathematics Content**

STEM proficient students will learn and apply rigorous content within science, technology, engineering, and mathematics disciplines to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

A. Demonstrate an understanding of science, technology, engineering, and mathematics contents.

Grade: Third through Fifth	**Instructional Examples and Notes**	**Resources**	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Explain concepts presented in grade level science, technology, *engineering*, and *mathematics* content. • Describe connections between *science*, *technology*, *engineering*, and *mathematics* content and real life. • Give examples of *science practices* or *Standards for Mathematics Practices* being used when solving problems. • Write a plan using the engineering design process when engaged in STEM activities. Demonstrate an understanding of *Maryland Technology Literacy Standards for Students* when engaged in STEM activities.	**Teacher Notes:** ○ Engage students in real world, open-ended, complex, inquiry based tasks. ○ Promote discourse through higher level questioning. ○ Provide opportunities for evaluating possible solutions and discussing the positive and negative factors of the solution. ○ Students use technologies to create possible products or modifications to products to address the problem.	**Engineering jobs list:** http://www.pike.k12.in.us/schools/nasc/classes/kwallace/types+of+Engineers.htm **STEM Resources:** http://www.stemresources.com/ **Levels of Inquiry:** http://tinyurl.com/7v9vea6	**Engineering Design Process-** The process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic science and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective.

STEM Standard of Practice 1: **Learn and Apply Rigorous Science, Technology, Engineering, and Mathematics Content**

STEM proficient students will learn and apply rigorous content within science, technology, engineering, and mathematics disciplines to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

B. Apply science, technology, engineering, and mathematics content to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Employ problem solving skills to *science* and *mathematics* content. • Use the appropriate *science*, *technology, engineering*, and *mathematics* content to solve real world problems or ask and answer complex questions. • Show the appropriate *science, technology*, or *mathematics* content when charting historical societal changes. • Examine ways *science*, *technology*, *engineering*, or *mathematics* content knowledge is used to better human life.	**Teacher Notes:** ○ To apply STEM content, teachers should keep in mind that STEM is a process in which science, technology, engineering, and mathematics content, practices and processes and other disciplines depend upon students learning content and be able to apply what they learned to answer complex questions, investigate global issues, solve real world problems, or challenges.	**A Framework for K-12 Science Education** http://www.nap.edu/catalog.php?record_id=13165 **Maryland Technology Literacy Standards for Students K-8** http://marylandpublicschools.org/NR/rdonlyres/CFAE6DE8-94E4-4D72-A1DE-50061B2B2A05/13089/MTLSSComplete1.pdf **Maryland Common Core State Curriculum Frameworks – Reading / English Language Arts** http://mdk12.org/instruction/curriculum/reading/index.html **Social Studies** http://mdk12.org/instruction/curriculum/social studies/index.html **Fine Arts** http://www.mfaa.msde.state.md.us/source/MDFA_index.asp	**Global issues-** Issues that impact the Earth, as a whole, problems that concern a population throughout the world. A global issue is an issue that's going on all over the world meaning it not only going on in a certain place. For example: global warming is a global issue, not like the oil spill it hasn't affected the whole world. **Real world problems-** Problems that actually occur in everyday life. **Challenges-** A problem or concern that should be addressed. A competition. **Complex question-** An open ended question that promotes higher order thinking skills and requires students to synthesize information from multiple sources to develop answers.

STEM Standard of Practice 2: **Integrate Science, Technology, Engineering, and Mathematics Content**

STEM proficient students will integrate content from science, technology, engineering, and mathematics disciplines as appropriate to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

A. Analyze interdisciplinary connections that exist within the science, technology, engineering, and mathematics disciplines and other disciplines.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Demonstrate how to connect *science*, *technology*, *engineering*, and *mathematics* disciplines to other disciplines. • Critique the appropriate connections between *science*, *technology*, *engineering*, and *mathematics* content to answer complex questions, investigate global issues, or solve real world problems or challenges. • Explain the process of using *science practices* or Standards for Mathematical Practices when answering complex questions, investigating global issues, or developing solutions to real world problems or challenges.	**Suggested Activities:** ○ Bridge to Terabithia: ○ Discuss the physics of bridge building. ○ Discuss proportional reasoning-scale model of bridges. ○ Compare bridge designs from around the world (successes and failures). ○ The Art of Design-architectural design options. ○ Create an opinion statement defending one architectural design feature over another for the same type of bridge. ○ Using the engineering design process, construct a scale model of a bridge of their own design. ○ Test the static load of your bridge and calculate the failure threshold. ○ Present findings in an authentic way: invite engineers to an open house of bridge models, or PowerPoint/ prezi presentations.	**Instructional Resources:** **Bridge to Terabithia Activity** http://childrensengineering.org/technology/Build_A_Bridge.pdf **General Activities that integrate one or more STEM disciplines w/ other content** https://www.istemnetwork.org/search.cfm?type=lesson&purposeid=66 **PD Resources:** **Integrate STEM** http://www.eschoolnews.com/2010/04/02/integrating-stem-in-the-elementary-years-your-lesson-plans-may-already-hold-the-answer/ **STEM Influenced Elementary Classroom** http://www.iteea.org/Publications/TandC/Sep09.pdf	**Engineering Design Process-** The process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic science and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective. **Connections-** The relationship of something with its context.

STEM Standard of Practice 2: **Integrate Science, Technology, Engineering, and Mathematics Content**

STEM proficient students will integrate content from Science, Technology, Engineering, and Mathematics disciplines as appropriate to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

B. Apply integrated science, technology, engineering, and mathematics contents to develop solutions to problems or construct answers to complex questions.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to; • Summarize and apply *science*, *technology*, *engineering*, and *mathematics* content when answering complex questions, investigating global issues and solving real world problems or challenges. *(CCSS RI.5.2)* • Demonstrate an understanding of how to integrate practices, as appropriate to other disciplines, when answering complex questions, investigating global issues, defining real world problems, developing models, or developing solutions to real world problems or challenges. • Explain why one connects multiple contents when answering complex questions, investigating global issues, defining real world problems, developing models, and developing solutions to real world problems or challenges.	**Teacher Note:** ○ When presented with an open ended task, students identify topic vs. issue using STEM content. **Suggested Activities:** ○ Conduct research using appropriate technologies and methodologies. ○ Brainstorm possible solutions to the issue. ○ Evaluate solutions. ○ Create products which would address the solution. ○ Present findings to an authentic audience.	**STEM Resources** http://www.stemresources.com/	**Topic-** Subject of conversation or discussion. **Issue-** Point of matter or dispute which is special to public importance. **Global issues-** Issues that impact the Earth, as a whole, problems that concern a population throughout the world. A global issue is an issue that's going on all over the world meaning it not only going on in a certain place. For example: global warming is a global issue, not like the oil spill it hasn't affected the whole world. **Real world problems-** Problems that actually occur in everyday life. **Challenges-** A problem or concern that should be addressed. A competition. **Complex question-** An open ended question that promotes higher order thinking skills and requires students to synthesize information from multiple sources to develop answers.

STEM Standard of Practice 3: **Interpret and Communicate Information from Science, Technology, Engineering, and Mathematics**

STEM proficient students will interpret and communicate information from science, technology, engineering, and mathematics to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

A. Identify, analyze, and synthesize appropriate Science, Technology, Engineering, and Mathematics information (text, visual, audio, etc.).

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Read, listen or view (text, visual, audio, etc) information related to *science*, *technology*, *engineering*, and *mathematics* to answer complex questions, investigate global issues, or solve real world problems, or challenges. *(CCSS RI.5.7)* • Analyze multiple sources of information to understand complex questions, investigate global issues, real world problems or challenges. *(CCSS RI. 5.6)*	Teacher Notes: ○ Use the CCSC in E/LA to teach students to dissect complex text. ○ Extrapolate information from text, visual, or audio based on the domain specific vocabulary.	**MCCSC Frameworks – Reading / English Language Arts** http://mdk12.org/instruction/curriculum/reading/index.html (CCSS 5 RI, 3) **Levels of Inquiry:** http://tinyurl.com/7v9vea6 Analyze: http://teachers.net/lessons/posts/4206.html **Synthesize:** http://ohiorc.org/adlit/strategy/strategy_each.aspx?id=2 http://www.bcps.org/offices/lis/models/tips/synthesizing.htm **Text complexity** http://www.uft.org/teacher-teacher/using-text-complexity-classroom	**Domain specific vocabulary**- The terminology of a particular field of knowledge or content.

STEM Standard of Practice 3: **Interpret and Communicate Information from Science, Technology, Engineering, and Mathematics**

STEM proficient students will interpret and communicate information from Science, Technology, Engineering, and Mathematics to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

B. Apply appropriate domain specific vocabulary when responding and discussing Science, Technology, Engineering, and Mathematics contents.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Determine the meaning of general academic and domain-specific vocabulary or phrases in text relevant to grade 5 topic or subject area. *(CCSS RI. 5.4; SC, 5)* • Determine the meaning of symbols, words or key terms used in *science*, *technology*, *engineering*, and *mathematics. (See MTLSS 3,4&5.4.B.1a)* • Apply appropriate academic and domain-specific vocabulary when responding either orally or in writing to text-specific questions. *(CCSS RI. 5. 1)* • Use academic and domain-specific vocabulary when explaining either orally or in writing the organizational structure of a text or print of a text. *(CCSS RI.5. 5; See CCSS W.4. 9; L6)* • Apply academic and domain-specific vocabulary when writing about or discussing informational texts. *(CCSS RI. 5.2; See CCSS W.5.9; L9)* • Apply academic and domain-specific vocabulary to discuss and/or write any types of relations. *(CCSS RI.5. 3; See CCSS LS. 5. 6)*	**Suggested Activities:** ○ "Reverse Bingo": ○ **Illustrate the vocabulary words** on one side of a sheet of paper. The word is written on the back. These can be used as a "quiz show" for a whole-class activity, with one student acting as moderator, or they can be placed on a bulletin board or hallway display with the words added at the bottom. ○ **Vocabulary bee-** this is similar to a spelling bee, but in addition to spelling each word correctly, the game participants must correctly define the words as well. ○ **Vocabulary concentration-** the goal of this game is to match vocabulary words with their definitions. ○ Practice their writing skills by creating sentences and paragraphs in which multiple vocabulary words are used correctly. ○ Ask them to share their **compact vocabulary** sentences and paragraphs with the class.	MCCSC Frameworks – ELA http://mdk12.org/instruction/curriculum/reading/index.html (CCSS 5 RI, 4) Vocabulary Bingo: http://www.education.com/activity/article/Vocabulary_Bingo_Third through Fifth/ http://www.teachervision.fen.com/vocabulary/lesson-plan/43187.html	**Domain specific vocabulary**- The terminology of a particular field of knowledge or content. **Academic Vocabulary**- Terms necessary for understanding ideas across curricular areas.

STEM Standard of Practice 3: **Interpret and Communicate Information from Science, Technology, Engineering, and Mathematics**

STEM proficient students will interpret and communicate information from Science, Technology, Engineering, and Mathematics to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

C. Engage in critical reading and writing of technical information.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Apply appropriate strategies before reading, viewing, or listening to text. *(CCSS RI. 5.1)* • Analyze words and symbols from informational text to examine meaning. • Summarize an informational text, either orally or in writing, including the main ideas and significant supporting information from across the text. *(CCSS RI. 5.2;See CCSS RL.4.2; W9; SL.4.6;See MS SLM 4-5.6.A.1bi)* • Draft introduction that addresses audience needs and the writing purpose. *(CCSS W.5.1.a; MTLSS 3, 4&5. 4.A.1c)* • Create models, graphics and drawings to communicate relevant textual evidence. *(CCSS RI. 5.7;MTLSS 3,4&5.4.D.1b)*	**Suggested Activities:** ○ Teach the difference between technical and creative writing. ○ Give students examples of technical writing: recipes, memos, power points, writing up a science lab, "how to", etc. ○ Present to a Professional Audience: ○ plan ○ identify the audience ○ organize the content ○ choose the media ○ practice ○ perform	**MCCSC Frameworks – ELA** http://mdk12.org/instruction/curriculum/reading/index.html **(CCSS 5 RI 3)** **(CCSS 5 SL, 4)** **Technical Writing: Both Instructional Resource and PD Resource** http://engr.arizona.edu/future/files/tech_writing_overview.pdf **Presenting information (PD)** http://www.buzzle.com/articles/presenting-information-to-an-audience.html	**Create-** To bring something into existence; to use imagination to invent things or produce works of art; to result in something or make something happen. **Informational text** Includes literary non-fiction, expository text, technical text, procedural text, and functional text. **Technical writing-** Treating a document with the goal of providing clear and concise information, rather than entertainment or story telling; a technical document/report incorporates diagrams and multi-media information to provide technical information. **Relevant information**- Knowledge gained through study, communication, research, instruction etc. pertinent to a learning activity.

STEM Standard of Practice 3: **Interpret and Communicate Information from Science, Technology, Engineering, and Mathematics**

STEM proficient students will interpret and communicate information from science, technology, engineering, and mathematics to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

D. Evaluate and integrate multiple sources of information (e.g.: quantitative data, video and multimedia) presented in diverse formats.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Sources of information from *science*, *technology*, and *mathematics* to address questions, investigate global issues or solve real world problems or challenges. • Analyze multiple sources for accuracy and relevancy. • Compare and contrast the overall structure (e.g. chronology, comparison, cause/effect, and problem/solution) of events, ideas, concepts, or information in two or more texts. *(CCSS RI.5.5)* • Analyze information from multiple texts or sources to answer complex questions, investigate global issues, and solve real world problems or challenges. *(See MTLSS 3,4&5.4.C.1a)*	**Suggested Activities:** ○ Utilize multiple media formats to research an issue, such as global warming or local environmental issues, to generate ideas in driving solutions. ○ text ○ podcast ○ vodcast ○ real-time data ○ computer models ○ video	**Maryland Common Core State Curriculum Frameworks – Reading / English Language Arts** http://mdk12.org/instruction/curriculum/reading/index.html (CCSS 5 SL, 5) **Global Warming multi-media:** http://environment.nationalgeographic.com/environment/global-warming/ **Vodcast-** a video podcast www.youtube.com/watch?v=JMS-4wNO03g	**Global issues-** Issues that impact the Earth, as a whole, problems that concern a population throughout the world. A global issue is an issue that's going on all over the world meaning it not only going on in a certain place. For example: global warming is a global issue, not like the oil spill it hasn't affected the whole world. **Real world problems-** Problems that actually occur in everyday life. **Challenges-** A problem or concern that should be addressed. A competition. **Complex question-** An open ended question that promotes higher order thinking skills and requires students to synthesize information from multiple sources to develop answers.

STEM Standard of Practice 3: **Interpret and Communicate Information from Science, Technology, Engineering, and Mathematics**

STEM proficient students will interpret and communicate information from science, technology, engineering, and mathematics to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

E. Develop an evidence-based opinion or argument.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Apply the prewriting and planning stages of the writing process to include formulating an opinion. *(CCSS W.5. 1a)* • Differentiate facts or reasons from opinion(s) and select facts and/or details that support reasons. *(CCSS W.5.1b)* • Critique the opinions/arguments of individuals and/or group. *(CCSS SL. 5.1b)* • Write a conclusion that paraphrases the opinion or point of view. *(CCSS W.5.1d; CCSS W.3.4.5.6).* • Cite sources to support an evidence-based opinion.	**Suggested Activities:** ○ Damage to the environment is an inevitable consequence of improvements to the standard of living. The destruction of the world's forests is inevitable as our need for land and food grow. *Why do you agree or disagree?* ○ Are our zoos cruel to wild animals? Are zoos are necessary for education? *Discuss some of the arguments for and against keeping animals in zoos.* ○ Technology is making communication easier in today's world, but at the expense of personal contact as many people choose to work at home in front of a computer screen. What dangers are there for a society that depends on computer screens rather than face-to-face contact for its main means of communication? ○ Does modern technology make life more convenient, or was life better when technology was simpler? In what ways have information practices changed in the past 10 years?	**MSCCS Frameworks – Reading / English Language Arts** http://mdk12.org/instruction/curriculum/reading/index.html (CCSS 5 RI 8) (CCSS 5 W, 7) **Interactive for Writing to Persuade:** http://www.readingrockets.org/strategies/persuasive_writing/ http://www.buzzle.com/articles/essay-topics-for-kids.html http://www.readwritethink.org/files/resources/interactives/persuasion_map/ http://www.readwritethink.org/professional-development/strategy-guides/persuasive-writing-30142.html	**Evidence-** Facts, figures, details, quotations, or other sources of data and information that provide support for claims or an analysis that can be evaluated by others; should appear in a form and be derived from a source widely accepted as appropriate to a particular disciplines, as in details or quotations from a text in the study of literature and experimental results in the study of science. **Opinion-** A view or judgment formed about something.

STEM Standard of Practice 3: **Interpret and Communicate Information from Science, Technology, Engineering, and Mathematics**

STEM proficient students will interpret and communicate information from Science, Technology, Engineering, and Mathematics to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

F. Communicate effectively and precisely with others.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Select print, online, and multimedia sources with appropriate facts and relevant descriptive details about topic. *(CCSS SL.5.4)* • Share information in an appropriate format for written, oral, sound, and/or visual presentations. *(CCSS SL.5.5)* • Differentiate media types for audience, environment, and purpose of presentation. *(CCSS SL.5.5)* • Take notes and record information in a variety of formats as needed, including technology. *(CCSS SL.5. 3)* • Use appropriate non-verbal techniques to enhance communication, e.g., posture, eye-contact, facial expressions, gestures. *(CCSS SL.5.4)* • Communicate thoughts and ideas through a variety of forms, e.g. written, visual or auditory. *(See MTLSS 3,4&5.4.C.1a)*	**Suggested Activities:** ○ The Samoan Circle. ○ The Discourse Circle- involve students in structured, evidence-based conversations around challenging statements, use a paper with a circle drawn on it, divide the circle into 4 sections, have student write vocabulary words/opinions/arguments which are on topic in the sections of the circle, have students conduct a conversation using the information on the circle as a guide. ○ The Socratic Discussion. ○ The Titan pad. ○ Wall Wisher.	**Maryland Common Core State Curriculum Frameworks – Reading / English Language Arts** http://mdk12.org/instruction/curriculum/reading/index.html (CCSS 5 SL, 1) (CCSS 5 RL, 4) (CCSS 5 RI 1) **Samoan Circle** http://www.kstoolkit.org/Samoan+Circle http://delta-edu.com/downloads/samples_seeds/1356094_SG_PM_What_About_Pluto.pdf http://www.socrative.com/ http://titanpad.com/ http://www.wallwisher.com/	**Technology-** Human innovation in action that involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities. **Evidence-** Facts, figures, details, quotations, or other sources of data and information that provide support for claims or an analysis that can be evaluated by others; should appear in a form and be derived from a source widely accepted as appropriate to a particular disciplines, as in details or quotations from a text in the study of literature and experimental results in the study of science.

STEM Standard of Practice 4: **Engage in Inquiry**

STEM proficient students will engage in inquiry to investigate global issues, challenges, and real world problems.

A. Ask questions to identify and define global issues, challenges, and real world problems.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Ask complex questions related to: a. *science*, *technology*, *engineering*, and *mathematics*. b. investigating global issues, solving real world problems or challenges. *(MS SLM 4-5. 6.A.1d)* • Pose questions that elicit higher order thinking responses. *(SS.5.6.C.2.d)* • Use prior knowledge to individually formulate and refine questions to meet an informational needed. *(MS SLM 4:51.B.3.b)* • Create research questions about global issues, social problems or challenges that are grade level appropriate and based on student or class interest. • Use background information to refine researchable questions. *(MS SLM 4:5.3.A.1.a)* • Refine questions to investigate global issues or to solve real world problems or challenges. Develop a plan for how the answer complex questions about real world problems or situations. *(SS.5.6.C.2.f.)*	**Teacher Notes:** ○ Using websites such as http://wonderopolis.org/, teachers can model the how to ask complex questions based on observations of their world. ○ Teachers should model the best way to effectively ask questions ○ http://questioning.org/Q7/toolkit.html ○ http://www.youthlearn.org/learning/teaching/techniques/asking-questions/asking-questions ○ Teachers should use the scientific inquiry approach. Respond to questions with more questions. Utilize class discussions and labs to create more questions than set answers. ○ http://teachingtoday.glencoe.com/howtoarticles/what-is-inquiry-in-science ○ Use the 5E model ○ http://faculty.mwsu.edu/west/maryann.coe/coe/inquire/inquiry.htm	**Maryland Common Core State Curriculum Frameworks – Reading / English Language Arts** http://mdk12.org/instruction/curriculum/reading/index.html **(CCSS 5 RI 1)** **Engineering Design Process** http://www.theworks.org/files/docs/EDP_final_11x17.pdf http://www.iteea.org/TAA/PDFs/xstnd.pdf (this is a k-12 document) **Standards of Mathematical Practice 1 through 8**	**Global issues-** Issues that impact the Earth, as a whole, problems that concern a population throughout the world. A global issue is an issue that's going on all over the world meaning it not only going on in a certain place. For example: global warming is a global issue, not like the oil spill it hasn't affected the whole world. **Real world problems-** Problems that actually occur in everyday life. **Challenges-** A problem or concern that should be addressed. A competition. **Complex question-** An open ended question that promotes higher order thinking skills and requires students to synthesize information from multiple sources to develop answers.

STEM Standard of Practice 4: **Engage in Inquiry**

STEM proficient students will engage in inquiry to investigate global issues, challenges, and real world problems.

B. Conduct research to refine questions and develop new questions.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Identify evidence needed to solve real world problems, or challenges. • Collect information that may affect the understanding of complex questions, real world problems, or global issues. • Use keywords and text features to find information within a specific source. *(MS SLM 4-5 3.A.1.a)* • Develop new questions using information from *science*, *technology*, *engineering*, and *mathematic*s content. *(MS SLM 4-5.1.A.1c)* • Reflect on and refine research questions, theses, hypotheses, or positions based on new information discovered in the inquiry process. *(MS SLM 6:8 3.C.3.a;MS SLM 4-5.5.B.1c-d)* • Refine questions based on information/evidence found by individual and/or group researched. *(MS SLM 4-5.1.B.3b)* • Apply safe practices for both assignment-related and personal online searches. *(MS SLM 4-5 2.A.2.b)*	**Teacher Notes: EDP: Scientific Method** **Inquiry Based Questioning:** These questions are intended for teachers to pose while interact with students engaged in inquiry processes. 1. What does this make you think of? 2. In what ways are these different? 3. In what ways are they the same? 4. What materials did you use? 5. What would happen if you ... 6. What might you try instead? 7. Tell me about your ...? 8. What does it look like? 9. What does it remind you of? 10. What does it feel/look like? 11. What can you do next time? 12. What can you tell me about it? 13. Tell me what happened. 14. What could you do instead? 15. Which one do you have more of? 16. Is one object longer/shorter than another? 17. What do you call the things you are using? 18. What can you tell me about the things you have? 19. How are you going to do that? 20. What do you feel, see, hear, taste, smell 21. How did you do that? 22. What will you do next after you finish that? 23. Is there anything else you could do/use? 24. How do you know? 25. What are some different things you could try?	**Maryland CCSS** 2 RL, 3 http://mdk12.org/instruction/curriculum/reading/idex.html **Engineering Design Process** http://www.theworks.org/files/docs/EDP_final_11x17.pdf **Scientific Method** http://www.sciencebuddies.org/science-fair-projects/project_scientific_method.shtml **Inquiry Questions** http://tlc.ousd.k12.ca.us/~acody/inquiryquery.html **Inquiry**http://www.thirteen.org/edonline/concept2class/inq **Inquiry and Research** http://www.accessola.com/action/positions/info_studies/html/research.html	**Complex Questions -** An open ended question that promotes higher order thinking skills and requires students to synthesize information from multiple sources to develop answers. **Inquiry-** A seeking or request for truth, information, or knowledge – an investigation.

STEM Standard of Practice 5: **Engage in Logical Reasoning**

STEM proficient students will engage in logical reasoning to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

A. Engage in critical thinking.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Construct answers to complex questions while investigating global issues, and developing solutions to real world problems or challenges. • Analyze the relationships and connections between the question and global issues, real world problems or challenges. • Create a plan or strategy for answering complex questions, solving global issues, and/or addressing real world problems. • Demonstrate an ability to reflect on one's own thoughts and the thoughts of others. • Evaluate one's own reflection and the reflections of others while engaged in decision-making, investigation, or problem-solving.	**Teacher Notes:** Provide quotes in the area of study and ask for responses to the quote at the beginning and after they have studied the issue. **Suggested Activities:** ○ STEM Overarching Idea: In what ways might you compare the elements of change in a system and determine its positive and negative factors? ○ Demonstrate: The world's water supplies are facing new threats; affordable, advanced technologies could make a difference for millions of people around the world. By far most of the world's water is in the oceans, and therefore salty and not usable for most purposes without desalination. In what ways might we compare desalination techniques and determine both the positive and negative factors? Can you devise a simple method that can be used for large quantities of water that can be safe and accessible? ○ Evaluate: After researching opposing views about an issue, students either choose or are assigned to a position and debate the affirmative or negative to that issue.	**Engineering/Desalination Ideas:** http://www.engineeringchallenges.org/cms/8996/9142.aspx www.edutopia.org/grade-level-3-5 http://www.ehow.com/how_5461279_design-desalination-experiments.html http://science.howstuffworks.com/environmental/earth/oceanography/desalination.htm	**Demonstrate –** Explain or describe how something works or how to do something; show or prove something clearly and convincingly. **Evaluate-** Judge the product (effectiveness); judge the process (efficiency). **Investigation-** An examination or inquiry into something, especially a detailed one that is undertaken officially, or the act of undertaking an examination.

STEM Standard of Practice 5: **Engage in Logical Reasoning**

STEM proficient students will engage in logical reasoning to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

B. Evaluate, select, and apply appropriate systematic approaches (scientific investigations, engineering design processes, and/or mathematical practices).

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Select the grade appropriate systematic approach: scientific or engineering design process etc. to investigate global issues or solve real world problems or challenges. • Determine whether systematic approaches can be applied to multiple disciplines. • Evaluate systematic approaches that can be used to explore questions, global issues, or real world problems. • Monitor the progress toward answering questions, investigating global issues or solving real world problems or challenges. • Analyze and interpret data accurately and appropriately *(See MS SLM 4-5. 4. 2b).* • Evaluate and explain why some information may not be found or known. • Apply and evaluate systematic approaches when designing new or yet to be invented models, and to solve current or future real world problems. Apply *science practices and Standards for Mathematical Practices* to answer complex questions, investigate global issues, and solve real world problems or challenges related to STEM.	**Suggested Activities:** ○ Conduct investigations using the appropriate approach (i.e. scientific process, engineering process) to answer questions and solve problems. ○ Apply methods and concepts to new situations; be able to compare and discriminate between ideas; assess the value of theories and presentations in order to answer questions related to specific content. ○ Identify and apply mathematical practices used in solving these problems (i.e. What mathematical practice did the student/group use when solving the problem) ○ Analyze and interpret data, during investigations, in order to make generalizations, verify the value of evidence, and determine the validity of results. (ie. have students create survey, collect data, analyze data to determine results of survey). SW apply this skill to analyzing data collected from solving more complex problems while investigating global issues.	**Engineering Design Process** http://www.theworks.org/files/docs/EDP_final_11x17.pdf http://www.iteea.org/TAA/PDFs/xstnd.pdf **Maryland Common Core Mathematical Practices** http://mdk12.org/instruction/curriculum/mathematics/index.html **New Science Framework** http://www.nap.edu/catalog.php?record_id=13165	**Engineering Design Process-** The process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic science and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective. **Systematic approach-** Repeatable and learnable through a step by step procedure.

STEM Standard of Practice 5: **Engage in Logical Reasoning**

STEM proficient students will engage in logical reasoning to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

C. Apply science, technology, engineering, and mathematics contents to construct creative and innovative ideas.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Create or improve upon innovative ideas or existing products that use the knowledge of *science*, *technology*, *engineering*, and *mathematics* content. • Ask and answer complex questions to construct creative and innovative ideas. • Imagine and brainstorm ways to find possible solutions to current real world problems or challenges. • Design models that show innovation and creativity. • Present finished models or future plans for designing and building creative and innovative models in a public speak, display or exhibit.	**Suggested Activities:** ○ Design a model demonstrating the water cycle using various media types. ○ Design a water filtration system. ○ Create a PowerPoint (or other display format) debating the benefit/cost of electric cars vs. gas powered cars. ○ Design/create a way to make everyday products better, such as pencils, books, shoes, clothes, tools, etc. ○ Develop a model demonstrating the mechanism behind plate tectonics and associated geologic events. ○ Design a model demonstrating the rock cycle.	**Accidental Inventions** **Scientists who changed the world** **Rome for Kids** **Egypt for Kids** **Incas for Kids** **Environmental Resources** **Logical Reasoning** **Groundwater Resources**	**Innovative –** Demonstrating originality and inventiveness in work; developing, implementing and communicating new ideas to others; being open and responsive to new and diverse perspectives. **Innovation-** An improvement of existing technological product, system, or method of doing something.

STEM Standard of Practice 5: **Engage in Logical Reasoning**

STEM proficient students will engage in logical reasoning to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

D. Analyze the impact of global issues and problems at the local, national, and international levels.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Demonstrate an understanding of how history changes human life where you live and around the world. • Use geographic tools to locate places and describe human and physical characteristics… *(SS.5.3.A.1)* • Compare and contrast *science*, *technology,* and *engineering* used past and present. • Research the history or origin of a global issues, real world problems, or challenges. • Gather information, including data from a variety of print, digital and multimedia resources, to build background knowledge/awareness, and to answer complex questions about the global issues identified. • Analyze historical or current events that include *science*, *technology*, *engineering*, and *mathematics* content and that may have had an impact on changing or making better the life of people, animals, environment … locally, nationally, and internationally.	**Suggested Activities:** ○ Create a presentation/demonstration of an accidental scientific invention (i.e. penicillin). ○ Research and report on a historical scientist/inventor (Edison, Newton, Einstein, etc.) outlining how their inventions/ideas changed the world. ○ Compare/contrast the scientific/technical accomplishments of the Roman, Incan, or Egyptian Empires, and how some of those ideas/technologies are still used today.	**Prezi Presentations** **Geology** **Engineering for Kids** **Electric vs Gas Car** **Global Climate Change** **Environmental Resources**	**Innovative-** Demonstrating originality and inventiveness in work; developing, implementing and communicating new ideas to others; being open and responsive to new and diverse perspectives.

STEM Standard of Practice 6: **Collaborate as a STEM team**

STEM proficient students will collaborate as a STEM team to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

A. Identify, analyze, and perform a Science, Technology, Engineering, and Mathematics specific subject matter experts (SME) role.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary

Essential Skills and Knowledge
By the end of grade 5 students should be able to:
 	
• Analyze and apply knowledge using *science*, *technology*, *engineering*, and *mathematics* content while engaged in a specific subject matter expert role(s).
• Describe how available resources affect specialization and trade. *(SS.5.4.A.2.b).*
• Identify and analyze the different STEM professions.
• Identify and employ themselves or others as subject matter experts.
• Employ the willingness and positive behaviors to cooperate and collaborate with others.
• Perform multiple duties of the subject matter expert within a group or team to complete a task(s).
• Determine the STEM team's goal before engaging in STEM activities.
	Teacher Notes:
	
	Student discourse and collaboration are essential to successful implementation of STEM based tasks. Refer to the listed resources for suggestions to develop collaboration.
	
	Suggested Activities:
	
	○ Have students identify their areas of strength, areas of excellence even if they do not regularly gravitate towards and those that they always shy away from. (Keep all year for student self-reflection.).
	  ○ Target basic skills (thinker, builder, artist, actor, and speaker).
	  ○ Subject Matter Expert (SME).
	  ○ STEM task job descriptions.
	
	○ Grouping: tailor job descriptions based on STEM task given (architect, designer, IT, researcher, budget specialist, materials acquisition, waste management, etc.).
	
	○ Assignments should be assigned in a variety of ways; students can choose for themselves, can be assigned based on strengths, weaknesses, SMEs, etc.).
		Collaborative Grouping: http://www.srri.umass.edu/topics/collaborative-group-techniques
		
		Susan Baum link: http://tinyurl.com/77thnpw
			SME- A subject matter expert or domain expert is a person who is an expert in a particular area or topic.

STEM Standard of Practice 6: **Collaborate as a STEM team**

STEM proficient students will collaborate as a STEM team to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

B. Share ideas and work effectively with a STEM focused multidisciplinary team to achieve a common goal.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Explain the role of individuals and groups in creating rules and laws to maintain order, protect citizens, and provide services. *(SS.3.1.A.1)* • Develop and follow group rules and procedures. • Develop personal and group performance goals and expectations before and during STEM activities. • Determine the team's focus to represent a multidisciplinary team. • Comprehend and apply information from others within a STEM focus and multidisciplinary team to achieve a common goal. • Demonstrate perseverance while working with others a STEM focus and multidisciplinary team to complete a task or common goal. • Develop a plan of action to achieve a common goal. • Assess individual or team's progress on meeting the goal of STEM activities.	**Fishbowl** Teams of three or four work on a task. At the same time, other teams of three or four observe the first teams. In particular, the first teams work on seeking other points-of-view, listening to and paraphrasing ideas, and other communication skills while solving the given problem. The second teams focus their attention on the team dynamic and make sure they are prepared to discuss how well or poorly the first teams worked together to solve the problem. (There is sometimes the tendency of the second teams to focus on the problem rather than the team dynamic.) After some time (even if every team has not finished the problem), the class discusses what happened and what didn't happen during the activity. **Jigsaw** If there is reading material (such as background) to be digested before doing an activity, split it up into 3 or 4 self-contained parts. Divide the class into the same number of Reading Groups, with one member from each team. Give one part of the reading to each team to digest and to prepare to explain to their team. Then rearrange the students so that each team has someone who has read one of the self-contained parts, and have each student teach his/her part of the reading to the rest of the team.	**Collaboration:** http://www.lessonplansinc.com/classroom_management_collaborative_learning.php **Destination Imagination – Team Building Instant Challenges** http://www.idodi.org/ **Professional Development Resources:** http://www.schreyerinstitute.psu.edu/pdf/Commonly_Asked_Questions_about_Teaching_Collaborative_Activities.pdf	

STEM Standard of Practice 6: **Collaborate as a STEM team**

STEM proficient students will collaborate as a STEM team to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

C. Listen and be receptive to ideas of others.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Listen to and receive the *science*, *technology*, *engineering*, and *mathematics* content knowledge, personal experiences, ideas, and view point/perspectives of others in the team. • Repeat and recall knowledge, experiences, and view point/perspectives of others. • Apply strategies that promote active listening. • Identify the main idea of a group discussion. • Listen and ask questions to get a deeper understanding of key ideas or thoughts of others. • Clarify what others have shared and understand what others have said. • Analyze how conflict affected relationships among individuals and groups, such as early settlers and Native Americans, free, and enslaved people. *(SS.5.2.C.1.a)*	**Teacher Notes:** ○ Become an Active Listener by: ○ Paying attention. ○ Showing that you are listening. ○ Providing feedback. ○ Deferring judgment. ○ Respond Appropriately. ○ Summarize, then Respond to Other's Perspectives in Speaking and Writing: ○ Appropriately, citing informational text. ○ Respectfully, disagree with explanation. ○ In writing, defend your position using facts. ○ Correctly, always proofread your work.	**Active Listening** http://www.mindtools.com/CommSkll/ActiveListening.htm	**Active listening-** Listening that focuses entirely on what the other person is saying and confirms understanding of both the content of the message and the emotions and feelings underlying the message to ensure that understanding is accurate.

STEM Standard of Practice 6: **Collaborate as a STEM team**

STEM proficient students will collaborate as a STEM team to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

D. Analyze career opportunities that exist in a variety of STEM fields relevant to the STEM focused multidisciplinary team's goal.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Compare and analyze how assorted careers in the STEM fields engage in teams to solve real world problems and explore solutions to challenges. • Demonstrate an understanding of the content knowledge, skills, and behaviors many STEM professions apply when working as a team to achieve common goal. • Research several engineering careers in order to understand the career knowledge and behavioral expectations from a variety of engineering professions. • Evaluate how different STEM professionals work together to solve real world problems. • Perform the role of a STEM professional to accomplish STEM team goals.	**Teacher Notes:** Students should see real life examples of SME's. STEM field careers require problem solving and collaboration both within the classroom setting and in the global workforce. **Suggested Activities:** ○ Invite "experts in the field" to discuss content, career opportunities and areas of strength needed for the particular SME. ○ Role play various jobs in a STEM related career. ○ Present careers in a job fair format, invite other grade levels to learn about the STEM related careers.	**Women in Science** http://www.mdwomensheritagecenter.org/	**Role-** The actions and activities assigned to or required or expected of a person or group; "the function of a teacher"; "the government must do its part"; "play its role."

STEM Standard of Practice 7: **Apply Technology Strategically**

STEM proficient students will apply technology appropriately to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

A. Identify and understand technologies needed to develop solutions to problems or construct answers to complex questions.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Demonstrate an understanding of how technology can help improve human life. • Explain how the development of new products and new technology affected the way people lived. *(SS.5.4.A.3.a)* • Research a range of technological tools people use every day. • Ask and answer complex questions about how technology can be used to solve real world problems or challenges. • Identify and explain ways people use technology to solve real world problems or challenges. • Create and write interview questions for professionals in the real world who use technology tools to solve real world problems. • Present information on how technology works in many STEM field.	**Suggested Activities:** ○ Ask and answer complex questions about technology, such as: ○ What, how and/or why do people use the following technologies: ○ pencils and/or computers are used to record information ○ chairs (e.g. chairs are used to sit on at home, in public places and/or a electrically controlled wheel chairs) ○ Tables (e.g. tables are used to eat food on, meeting tables, and/or operation tables etc.) ○ Communication devices and search engines used to get information.	**MD State Standards** http://mdk12.org/instruction/curriculum/technology_literacy/vsc_technology_literacy_standards.pdf http://mdk12.org/instruction/curriculum/technology_literacy/ComputerLiteracySkills.pdf	**Technological tool**- A device used by humans to complete a task. These tools may include rulers, protractors, computer softwares, CAD programs, etc. **Technology**- Human innovation in action that involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities. **Create-** To bring something into existence; to use imagination to invent things or produce works of art; to result in something or make something happen.

STEM Standard of Practice 7: **Apply Technology Strategically**

STEM proficient students will apply technology appropriately to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

B. Analyze the limits, risks, and impacts of technology.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Analyze and explain the limits of using technology when searching information, investigating global issues, and solving real world problems or challenges. • Identify and explain the risks in using technology when searching information, investigating global issues, and solving real world problems or challenges. • Evaluate how technology has positively or negatively impacts human life. • Present to a public audience the limitations and risks of using or not using technology.	**Suggested Activities:** ○ Choose a topic that is fictional but can be found on the internet (ie. tree frog). ○ Allow students to: ○ Conduct research ○ Evaluate the information critically. ○ Use that information to make a decision on the validity of the information. ○ Teach about accessing multiple sources when researching a topic electronically or in print.	**Technology Standard:** http://mdk12.org/instruction/curriculum/technology_literacy/vsc_technology_literacy_standards.pdf **Effectively Research Online:** http://dept.sccd.ctc.edu/tlc/resources/teach.html **MCCSC: ELA** http://mdk12.org/instruction/curriculum/reading/index.html http://www.corestandards.org/the-standards/english-language-arts-standards/reading-informational-text/grade-5/	**Limit**- A boundary. **Risk-** A factor, thing, element, or course involving uncertain danger; a hazard. **Technology- H**uman innovation in action that involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities.

STEM Standard of Practice 7: **Apply Technology Strategically**

STEM proficient students will apply technology appropriately to answer complex questions, to investigate global issues, and to develop solutions for challenges, and real world problems.

C. Engage in responsible/ethical use of technology.

Grade: Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Identify and demonstrate rules and responsibilities when using technology *(See MTLSS 3-5.2.B.1).* • Employ the policy of copyright protection when using information from numerous electronic devices *(See MTLSS 2.2.B.2a; MS SLM 4-5. 5.A.1f).* • Employ responsible and ethical behaviors when searching multiple online and digital resources using various technology tools, and sharing information while using different social medias *(See MTLSS 4. 2.1a; MS SLM 2-3. 5. A.2b)*. • Adhere to the safety guidelines, policies, and intended use of technological tools (e.g. copyright protections, cyber safety and ethics, school and school district technology use policy). *(adapted from MS SLM 4-5 2.A.2.a)* • Practice digital etiquette when sharing findings and conclusions. *(MS SLM 4-5. 5.A.2.b)* • Apply the school and school district use of technology policy. *(See MTLSS 3, 4&5 2.B.1a)*	**Teacher Notes:** In Grade 2, students became aware of Internet Safety Rules and the concept of "Netiquette". Grade 5 students should be able to identify these rules and norms and employ these behaviors appropriately. **Suggested Activities:** ○ PSA (podcast, voice thread, video) ○ Morning/Afternoon Announcements ○ Posters or skits for primary classrooms ○ Role-playing to create personal banks of appropriate responses for students to use to battle these issues.	**Teacher PD** **Cyberbullying:** http://kidshealth.org/parent/positive/talk/cyberbullying.html **Netiquette:** http://www.learnthenet.com/learn-about/social-netiquette/index.php **For students:** **Cyber bullying:** http://www.brainpop.com/technology/computersandinternet/cyberbullying/ **Voice Threading:** https://ed.voicethread.com/	**Netiquette-** Etiquette governing communication on the Internet. **Cyber bullying-** Harassing or being mean to someone in an online environment. **Copyright-** The exclusive legal right to reproduce, publish, sell, or distribute the matter and form of something.

STEM Standard of Practice 7: **Apply Technology Strategically**

STEM proficient students will apply technology appropriately to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

D. Improve or create new technologies that extend human capacity.

Grade: Third - Third through Fifth	Instructional Examples and Notes	Resources	Glossary
Essential Skills and Knowledge By the end of grade 5 students should be able to: • Analyze the chronology and significance of key events (related to technology) during the age of European exploration (or today). *(SS.5.5.A.1)* • Demonstrate an understanding of how technology can change. • Create ideas and model products that can improve the life of people and animals *(MTLSS 3, 4&5.2.A.1B)*. • Share creative and innovative ideas and models to a public audience or view for public display *(MTLSS 3, 4&5, 4.A.1b).* • Design and build models using technological tools. • Explain how the development of new products and new technologies affected the way people lived. *(MTLSS 3,4&5.2.A.1c;SS.4.5.3a)*	**Suggested Activities:** ○ Create a new product and defend its use for improving the quality of life for people or animals. ○ Interview two generations of relatives to compare and contrast a form of technology (phones, televisions, cars, personal computers) between the three generations. Students should project the next generation of the product. ○ Use Edmodo, Skype, or Podcasting to share the new product with the public.	**Destination Imagination – Team Building Instant Challenges** http://www.idodi.org/ www.edmodo.com www.glogster.edu www.skype.com (virtual interaction) **MCCSC-ELA** http://mdk12.org/instruction/curriculum/reading/index.html http://www.corestandards.org/the-standards/english-language-arts-standards/reading-informational-text/grade-5/	**Create-** To bring something into existence; to use imagination to invent things or produce works of art; to result in something or make something happen. **Innovative-** Demonstrating originality and inventiveness in work; developing, implementing and communicating new ideas to others; being open and responsive to new and diverse perspectives. **Technological tool**- A device used by humans to complete a task. These tools may include rulers, protractors, computer softwares, CAD programs, etc.

Appendix A

Abbreviations

Grades K - 5

CCSS W.K:5: Common Core State Standards Writing Grades K-5
CCSS RI.K.5: Common Core State Standards Reading Informational Text Grades K5
CCSS SL.K.5: Common Core State Standards Speaking and Listening Grades K-5
CCSS L.K.5: Common Core State Standards Language Grades K-5
CCSS RL.K:5: Common Core Reading Literature Grades K-5
SS K: 5: Maryland State Curriculum-Social Studies K-5
MS SLM K-5: School Library Media State Curriculum K-5
MTLSSS – Maryland Technology Literacy Standards for Students Grades K-5

Online Maryland State Curriculum-Content Standards

Content	Standards Online Websites
Science and Engineering	**A Framework for K:12 Science Education** http://www.nap.edu/catalog.php?record_id=13165
Technology	**Maryland Technology Literacy Standards for Students K:8** http://marylandpublicschools.org/NR/rdonlyres/CFAE6DE8:94E4:4D72:A1DE:50061B2B2A05/13089/MTLSSSComplete1.pdf
International Technology and Engineering Educator's Association (ITEEA)	**ITEEA** http://www.iteaconnect.org/TAA/PDFs/ListingofSTLContentStandards.pdf **Standards for Technology Literacy: Content for the Study of Technology** http://www.iteaconnect.org/TAA/PDFs/xstnd.pdf
Mathematics	Maryland Common Core State Curriculum Frameworks – Mathematics http://mdk12.org/instruction/curriculum/mathematics/index.html
Reading / English Language Arts	**Maryland Common Core State Curriculum Frameworks – Reading / English Language Arts** http://mdk12.org/instruction/curriculum/reading/index.html
School Library Media State Curriculum	**School Library Media State Curriculum** http://www.marylandpublicschools.org/NR/rdonlyres/EC67FB12-FE6B-464A-A2AD-D0C6307773E3/26323/MS_SLM_SC_Accepted_GRpk8.pdf
Social Studies	**Social Studies** http://mdk12.org/instruction/curriculum/social studies/index.html
Fine Arts	**Fine Arts** http://www.mfaa.msde.state.md.us/source/MDFA_index.asp

Appendix B

Elementary School STEM Standards of Practice Framework and Instructional Guide Glossary

Academic Vocabulary: Terms necessary for understanding ideas across curricular areas.

Access: A way or means of approach.

Accuracy: Degree of conformity of a measure to a standard value.

Action plan: A series of steps and/or activities that must be successfully completed to achieve a goal.

Active listening: Listening that focuses entirely on what the other person is saying and confirms understanding of both the content of the message and the emotions and feelings underlying the message to ensure that understanding is accurate.

Analogy: A comparison between two things for a purpose of explanation or clarification; see simile, metaphor.

Analysis: Identification and evaluation of data, material, and sources for quality of content, validity, credibility and relevance; student compares and contrasts sources and findings and generates summaries and explanations of source materials.

Analyze: To examine something in great detail in order to understand it better or discover more about it.

Anecdotal record: Significant incidents or specific, observable behaviors can be recorded by teachers in anecdotal records. These records provide cumulative information about students' development in the learning objectives of the language arts as well as their physical and social growth and development. By systematically collecting and analyzing anecdotal comments, teachers can evaluate students' progress and abilities to use language and then plan appropriate instruction.

Anecdotes: Brief interesting or amusing life stories used to make a point.

Applies technology to task: Understands the overall intent and the proper procedures for setting up and operating machines, including computers and their programming systems.

Apply: To bring into action; use; employ.

Argument: A purpose for writing using reasons or evidence to support a claim or opinion.

Brainstorming: A method of shared problem solving in which all members of a group spontaneously and in an unrestrained discussion generate ideas.

Challenges: A problem or concern that should be addressed. A competition.

Close read: Observing facts and details about a text and interpreting those details.

Collaboration: The ability to work effectively with diverse teams; be helpful and make necessary compromises to accomplish a common goal.

Communication: The successful transmission of information through a common system of symbols, signs, behavior, speech, writing, or signals.

Compare and contrast: Organizational structure in which the difference and similarities across or within two texts are highlighted or could demonstrate a preference for one thing over another.

Complex question: An open ended question that promotes higher order thinking skills and requires students to synthesize information from multiple sources to develop answers.

Complex text: A text whose complexity is determined by quantitative, qualitative, and reader task components.

Computer literacy: The terminology and range of skills required to successfully use computers and other devices associated with computers.

Connection: The relationship of something with its context.

Constraint: A limit to the design process. Constraints may be such things as appearance, funding, space, materials, and human capabilities.

Content: The subjects or topics covered in a book or document.

Copyright: The exclusive legal right to reproduce, publish, sell, or distribute the matter and form of something.

Create: To bring something into existence; to use imagination to invent things or produce works of art; to result in something or make something happen.

Creative problem solving: Process to identify problems, generate ideas, and create an action plan to solve the problem.

Creative thinking or ideas: The ability or power used to produce original thoughts and ideas based upon reasoning and judgment.

Critical reading: Means reading with the goal of finding deep understanding of a material, whether it is fiction or nonfiction. It is the act of analyzing and evaluating what you are reading as you progress, or as you reflect back.

Critical thinking: The ability to acquire information, analyze, and evaluate it, and reach a conclusion or answer by using logic and reasoning skills.

Cyber bullying: Harassing or being mean to someone in an online environment.

Cyberethics: Ethics related to computer usage.

Data: Collected information which can be quantitative (numerical) or qualitative (descriptive). Factual information used as a basis for reasoning, discussion, or calculation.

Decision-making: The act of examining several possible behaviors and selecting from**.**

Demonstrate: Explain or describe how something works or how to do something; show or prove something clearly and convincingly.

Design process: A systematic problem-solving strategy, with criteria and constraints, used to develop many possible solutions to solve a problem or satisfy human needs and wants and to winnow (narrow) down the possible solutions to one final choice.

Design: An iterative decision making process that produces plans by which resources are converted to products or systems that meet human wants or needs or to solve problems. To create or construct according to a plan.

Develop: To elaborate or expand in detail.

Digital etiquette: The conventional rules or personal behavior pertaining to courteous online practices. For example, considering sensitivities, multiculturalism, diversity, conventions, and tone.

Discipline: A formal branch of knowledge or teaching (e.g., biology, geography, and engineering) that is systematically investigated, documented, and taught.

Divergent questions: Open ended questions that have more than one correct answer, or more than one correct way to solve them.

Domain specific vocabulary: The terminology of a particular field of knowledge or content.

Educational technology: Using multimedia technologies or audiovisual aids as a tool to enhance the teaching and learning process.

Effectively: In an effective manner; "these are real problems that can be dealt with most effectively by rational discussion.

Engineer: A person who is trained in and uses technological and scientific knowledge to solve practical problems.

Engineering design process: The process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic science and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective.

Engineering design: The systematic and creative application of scientific and mathematical principles to practical ends such as the design, manufacture, and operation of efficient and economical structures, machines, processes, and systems.

Engineering: The profession of or work performed by an engineer. Engineering involves the knowledge of the mathematical and natural sciences gained by study, experience, and practices that are applied with judgment and creativity to develop ways to utilize materials and forces of nature for the benefit of mankind.

Environmental print: The identification or recognition of print or non-print in familiar settings.

Essential skills: What students need in order to master a specific STEM Standards of Practice Student proficiency.

Ethics: Moral principles that govern an individual or groups behavior.

Ethics: A set of moral principals or values; A theory or system of moral values (the present-day materialistic ethic); Plural but singular in construction; The principal of conduct governing a individual or group.

Etiquette: The conduct or procedure required by good breeding or prescribed by authority to be observed in social or official life.

Evaluate: To consider or examine something in order to judge its value, quality, importance, extent, or condition.

Evaluation: Judge the product (effectiveness); judge the process (efficiency).

Evidence: Facts, figures, details, quotations, or other sources of data and information that provide support for claims or an analysis that can be evaluated by others; should appear in a form and be derived from a source widely accepted as appropriate to a particular disciplines, as in details or quotations from a text in the study of literature and experimental results in the study of science.

Expository text: The nature of exposition; serving to expound, set forth, or explain.

Facilitate: To help bring about learning or make learning easier.

Figurative language/meaning: A type of language that does not mean explicitly what it says; contains words and phrases that require a reader to make inferences and use his/her imagination in order to create a more vivid image or real experience.

Figures of speech: a non-literal expression in which the meaning is ironic, metaphorical, or rhetorical.

Foundation questions: Questions that are derived from overarching questions. These are the "What is…" questions. Their answers are absolute and are usually singular (only one right answer).

Gather: To learn from information given; conclude or assume.

Global issues: Issues that impact the Earth as a whole, problems that concern a population throughout the world. A global issue is an issue that's going on all over the world meaning it not only going on in a certain place. For example: global warming is a global issue, not like the oil spill it hasn't affected the whole world.

Graphic organizer: Different ways to visually organize information.

Hypothesis: A tentative answer to a question, from which testable prediction can be generated.

I Do, We Do, You Do: An instructional strategy where practice is scaffolded to support the learners' needs. The teacher models for students, students work in groups for guided practice and then finally students work.

Identify: To recognize somebody or something and to be able to say who or what he, she, or it is.

Implication: Something suggested as naturally to be inferred or understood.

Independent(ly): A student performance done without scaffolding from a teacher, other adult, or peer.

Inference: A logical guess based on text evidence and the reader's prior knowledge.

Information: Knowledge gained through study, communication, research, instruction, etc.; factual data.

Informational text: Includes literary non-fiction, expository text, technical text, procedural text, and functional text.

Innovation: An improvement of existing technological product, system, or method of doing something.

Innovative: Demonstrating originality and inventiveness in work; developing, implementing and communicating new ideas to others; being open and responsive to new and diverse perspectives.

Inquiry based learning: Learning that can be applied to all disciplines. Individuals need many perspectives for viewing the world. Such views could include artistic, scientific, historic, economic, and other perspectives. While disciplines should interrelate, inquiry learning includes the application of certain specific "ground rules" that insure the integrity of the various disciplines and their world views.

Inquiry: A seeking or request for truth, information, or knowledge – an investigation.

Integrate: Combine knowledge from multiple disciplines.

Interdisciplinary: Across content or discipline areas.

Investigation: An examination or inquiry into something, especially a detailed one that is undertaken officially, or the act of undertaking an examination.

Issue: Point of matter or dispute which is special to public importance.

Language of the discipline: The language professionals in a given field use to communicate with their peers.

Lesson module: A unit of education or instruction with a relatively low student-to-teacher ratio, in which a single topic or a small section of a broad topic is studied for a given period of time.

Lesson: A period of instruction; a class. An assignment or exercise in which something is to be learned. An act or instance of instructing/teaching.

Limit: A boundary.

Listening: To hear something with thoughtful attention, to give consideration.

Local: In close proximity to a given location, community.

Logic: The ability to use reasoning to determine relationships among propositions in terms of implication, contradiction, contrariety, and conversion.

Logical reasoning: How things fit together.

Mathematical practices: Processes and proficiencies as described in a variety of mathematical expertise.

Mathematics: The science of numbers and their operations, interrelations, combinations, generalizations, and abstractions and of space configurations and their structure, measurement, transformations, and generalizations.

Metacognition: Is defined as "cognition about cognition", or "knowing about knowing." It can take many forms; it includes knowledge about when and how to use particular strategies for learning or for problem solving.

Model: A replica of a larger object or product.

Module: A self-constrained unit.

Netiquette: Etiquette governing communication on the Internet.

New: Unfamiliar or novel to the student.

Nonfiction/informational text: The branch of literature comprising works of narrative prose dealing with or offering opinions or conjectures upon facts and reality, including biography, history, and the essay.

Opinion: A view or judgment formed about something.

Overarching Questions: Questions that are not answerable with finality in a brief sentence. Typically, further research is required to answer overarching questions. Their aim is to stimulate thought, to provoke inquiry, and to spark more questions.

Piracy: Stealing computer software.

Plan: A scheme or method of acting, doing, proceeding, making, etc., developed in advance.

Precisely: Used to indicate that something is stated exactly; with absolute accuracy.

Primary source: A first-hand account of an event.

Prior knowledge: Information that a student knows before a lesson/instruction/research/exploration.

Problem solving: The process of understanding a problem, devising a plan, carrying out the plan, and evaluating the plan in order to solve a problem or meet a need or want.

Problem-base learning: (PBL) is a student-centered pedagogy in which students learn about a subject in the context of complex, multifaceted, and realistic problems (not to be confused with project-based learning).

Problems: An issue concerning one or more people.

Proficient: Performance that meets the criterion established in the Standards as measured by a teacher or assessment.

Proficiently: A student performance that meets the criterion established in the Standards as measured by teacher or assessment.

Project based learning: Is a systematic teaching method that engages students in learning important knowledge and 21st century skills through an extended, student-influenced inquiry process structured around complex, authentic questions and carefully designed products and learning tasks.

Prototype: A full-scale working model used to test a design concept by making actual observations and necessary adjustments.

Question: A request for information or for a reply, which usually ends with a question mark if written or on a rising intonation if spoken.

Real world problems: Problems that actually occur in everyday life.

Real world: The realm of practical or actual experience, as opposed to the abstract, theoretical, or idealized sphere of the classroom, laboratory, etc.

References: A spoken or written comment that either specifically mentions or calls attention to somebody or something or is intended to bring somebody or something to mind.

Refine: To clarify, improve, and polish a research question or information need throughout the inquiry process.

Relevant ideas: Any thoughts, conceptions, or notions pertinent to a learning activity.

Relevant information: Knowledge gained through study, communication, research, instruction etc. pertinent to a learning activity.

Research: Identification and utilization of appropriate strategies to explore and answer problems and to conduct research on a range of questions.

Researchable question: A clear and concise question that has a means of which to be answered through investigation.

Risk: A factor, thing, element, or course involving uncertain danger; a hazard.

Role: The actions and activities assigned to or required or expected of a person or group; "the function of a teacher"; "the government must do its part"; "play its role."

Runoff: The portion of precipitation on land that ultimately reaches streams often with dissolved or suspended material.

Science: Knowledge about or study of the natural world based on facts learned through experiments and observations.

Scientific method: A method of research in which a problem is identified, relevant data are gathered, a hypothesis is formulated from these data, and the hypothesis is empirically tested.

Self-directed: Monitoring one's own understanding and learning needs; demonstrating initiative to advance professional skill levels; **defining, prioritizing and completing tasks without direct oversight;** demonstrating commitment to lifelong learning.

Skill: An ability that has been acquired by training or experience.

Solution: The successful action of solving a problem, the answer that fixes the problem.

Source: A work, etc. supplying information or evidence (esp. of an original primary character) as to some fact, event, or series of these. Could also be a person supplying information, an informant, a spokesman.

Strategic reader: A student who naturally internalizes the reading process – before, during and after reading strategies.

Strategies: A plan, method, or series of maneuvers or stratagems for obtaining a specific goal or result.

Subject matter expert: A person who as comprehensive and/or authoritative knowledge or skill in a particular area or topic.

Synthesis: Organize from multiple sources; present the information.

Synthesize: To merge new information with prior knowledge, to form a new idea, perspective, or opinion: to generate insight.

Systematic approach: Repeatable and learnable through a step by step procedure.

Team: Cooperative learning strategies.

Technical audiences: Audience consisting of practitioners in the field of engineering, technology, design, business, and other workforce-related disciplines.

Technical information: Belonging to or involving a specialized subject, field, or profession.

Technical texts: Formula reading relating to or characteristic of a particular field.

Technical writing: Treating a document with the goal of providing clear and concise information, rather than entertainment or story telling; a technical document/report incorporates diagrams and multi-media information to provide technical information.

Technological tool: A device used by humans to complete a task. These tools may include rulers, protractors, computer softwares, CAD programs, etc.

Technology literacy: The ability to use, manage, understand and assess technology.

Technology: Human innovation in action that involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities.

Test: A method for collecting data; a procedure for critical evaluation.

Tool: Device for precise measurement and/or construction.

Topic: Subject of conversation or discussion.

Transdisciplinary: In the transdisciplinary approach to integration, teachers organize curriculum around student questions and concerns. Students develop life skills as they apply interdisciplinary and disciplinary skills in a real-life context. Two routes lead to transdisciplinary integration: project-based learning and negotiating the curriculum. (Drake & Burns, 2005)

Units: Are a series of lessons that address the same resource or theme.

Utilize: To put to use, especially to find a profitable or practical use for

Weigh: Assess the importance of (a contribution) in making a decision.

Appendix C

References

"**School Improvement in Maryland"—Glossary***

English Language Arts http://www.mdk12.org/instruction/curriculum/reading/glossary.shtml

School Library Media http://mdk12.org/instruction/curriculum/library_media/index.html

Social Studies http://mdk12.org/assessments/vsc/social_studies/bygrade/glossary.shtml

Technology Education http://mdk12.org/instruction/curriculum/technology_education/index.html

21st Century Skills http://www.p21.org/

Online References

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- Copyright - Adapted from http://www.copyrightkids.org/
- Creative Problem Solving Process - http://www.creativeeducationfoundation.org/our-process/what-is-cps
- Critical thinking - Adapted from http://dictionary.reference.com/browse/critical+thinking
- Cyberethics - Adapted from https://docs.google.com/viewer?a=v&q=cache:Ks6kijGdLylJ:iris.nyit.edu/~mtehrani/Week2_assignment1_MTehrani.pdf+&hl=en&gl=us&pid=bl&srcid=ADGEESiedhumnaTwb2KEVqbjj95ITRopzPbbN9pBTYmr7xX10KJxKeV3_xjSSYaB_iNG8vGW1vmVL1bXpxQwTTnQTsnxjSHtMOqeFuqWYwMos0vRmT3MzYNJcV9kbpsUJ80plLrFiCQL&sig=AHIEtbTBP_vhfRFUNC0QY4fltkm3epyCEw&pli=1
- Cybyer Bullying - Adapted from http://www.stopcyberbullying.org/
- "Dictionary.com" http://dictionary.reference.com/
- Divergent questions - Adapted from http://www4.uwsp.edu/education/lwilson/learning/quest2.htm
- Engineering Design Process - Adapted from http://www.me.unlv.edu/Undergraduate/coursenotes/meg497/ABETdefinition.htm
- Etiquette - Adapted from http://www.merriam-webster.com/dictionary/etiquette
- Global Issues -Adapted from http://dictionary.reference.com/browse/issue?s=t
- Hacking - Adapted from http://www.techterms.com/definition/hacker
- Implication - Adapted from http://dictionary.reference.com/browse/implication
- Issue - Adapted from http://dictionary.reference.com/browse/issue?s=t
- Jigsaw/expert group - definition adapted from: A cooperative learning structure where group members become experts in a given topic and teach the other members of the group. http://www.jigsaw.org (please add this link to our resource column) Engineering

Design Cycle - (Change to Engineering Design Process and delete Engineering Design Cycle from the Glossary) Design - http://www.merriam-webster.com/ Create - http://www.merriam-webster.com/ Adapts - http://www.merriam-webster.com/ Model - http://www.merriam-webster.com/ Tool - http://www.merriam-webster.com/ Innovation - adapted from Dictionary.com Cooperative learning strategies - (needs definition) Collaboration - http://www.merriam-webster.com/ Team - http://www.merriam-webster.com/ SME - Subject Matter Expert - MSDE Plan - http://www.merriam-webster.com/ SME - Subject Matter Expert - MSDE Listening - http://www.merriam-webster.com/dictionary/listen

- Netiquette - Adapted from http://www.bpl.org/kids/netiquette.htm
- Piracy - Adapted from http://www.techterms.com/definition/piracy
- Project-based learning - Adapted from http://pbl-online.org/About/whatisPBL.htm
- Science -Adapted from http://dictionary.reference.com/browse/science
- Scientific method - Adapted from http://www.me.unlv.edu/Undergraduate/coursenotes/meg497/ABETdefinition.htm
- Solution -Adapted from http://dictionary.reference.com/browse/solution?s=t